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MANAGEMENT OF FLUE GAS DESULFURIZATION (FGD) WASTE IN POLAND

Information on desulfurization methods in use, their contribution to the amount of flue gas purified annually, number of plants employing particular methods, amount of waste from processing plants, waste composition and utilization – was collected based on questionnaires sent out to industrial plants in Poland in 1998. 73% of questionnaires were answered which created a base for dividing the installations applied in Poland in waste treatment plants, depending on the type of manufacturing sector utilising them. A state of waste accumulation and utilization as well as prospects for utilization of flue gas desulfurization waste by individual industrial sectors have been estimated.

1. INTRODUCTION

Since the turn of the sixties a fast progress in flue gas desulfurization methods has resulted in occurring a new type of waste in the economically developed countries. Its nature and properties are related to a specific desulfurization method applied [1]. The wet lime/limestone method is most popular. The final product obtained, dihydrated calcium sulfate – gypsum, in West is known under the name of FGD gypsum, desulfogypsum or flue-gas gypsum, and in Poland as synthetic gypsum, industrial gypsum or desulfogypsum [2]. Assuming that for obtaining 2.8 Mg of gypsum 1 Mg of SO_2 is needed, the estimated quantity of this intermediare product awaiting utilization in Poland shall make over 3 million Mg in the year 2000 [3].

The purpose of the above mail survey was to assess approximately an actual state of accumulation of waste and the methods of their utilization, including the type of the desulfurization method applied and the production sector where the desulfurization method was used.

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2. MAIL SURVEY

2.1. METHODS OF FLUE GAS DESULFURIZATION

Information about the desulfurization methods applied, annual amount of treated flue gas, number of facilities in operation, and the amounts of waste have been summarized in table 1.

Table 1

Waste volumes, depending on the desulfurization method applied

Desulfurization method	Volume of treated flue gas, m^3n/year	Created wastes, Mg/year	Number of plants
Wet limestone	20.15×10^{10}	1 837 420.0	3
Wet lime	10.18×10^{9}	125 456.8	11
Semi-dry lime/limestone	14.37×10^{9}	177 474.5	9
Dry lime/limestone	44.26×10^{9}	291 024.5	10
Magnesium	3.13×10^{8}	193.3	3
Dual-alkali	10.10×10^{8}	2 480.2	5
Combustion in fluidal bed boiler	3.50×10^{7}	1 611.8	1
Waste sorbent	6.05×10^{8}	6 100.0	3

The data presented prove that there exists a general relation between the amount of the flue gas treated and the amount of waste formed. Predominant volume of the flue gas is treated by using the wet limestone method (74%), with the largest volume of waste formed (figure 1), although only few plants operate according to that method. A dry limestone method has a second position if the volume of the flue gas treated (16%) and the waste formed as well as the number of plants in operation are taken into account. Such a ranking is consistent with recently observed trends towards to the development and implementation of dry methods of flue gas desulfurization.

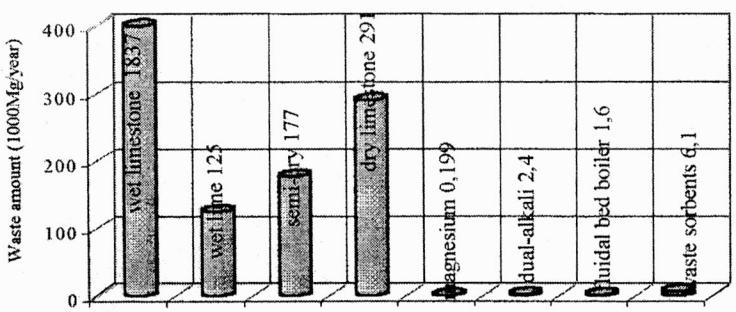

Fig. 1. Comparison of waste amount produced in FGD plants

No relation has been observed between the number of plants and the volume of wastes formed, or the volume of flue gas treated. According to survey data a total volume of waste formed during the flue gas desulfurization process in 1997 was 2.44 million Mg. Statistical data for 1998 published by GUS (Central Bureau for Statistics) [4] show 2.6 million Mg of solid waste formed as a result of using lime methods for flue gas desulfurization, which is 1.95% of total industrial waste for 1998. According to that information 57.4% of the waste formed during 1998 was utilized, 38.5% – deactivated (stored), and 4.1% – temporarily accumulated. However the GUS information bulletin does not specify the industrial sector, where the waste resulting from the flue gas desulfurization process is produced, nor does it take into consideration the waste utilization methods.

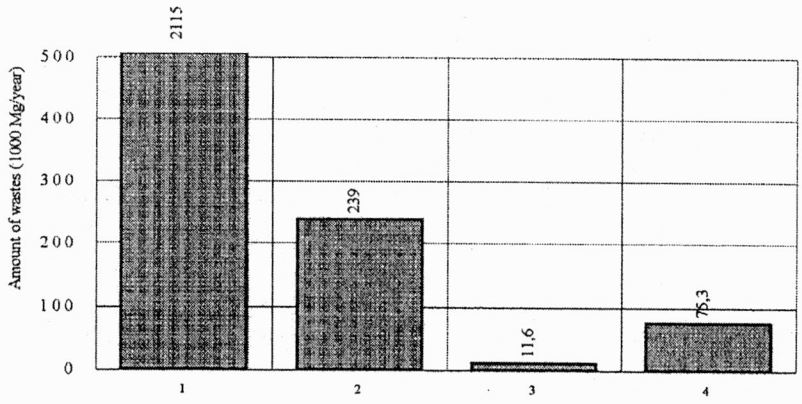

Fig. 2. Comparison of FGD waste amount produced in various branches of production: 1 – commercial power plant, 2 – municipal power plant, 3 – industrial power plant, 4 – industrial technologies

All the flue gas desulfurization plants, of which the relevant information had been found, can be classified according to the sector they belong to. They are as follows:

- Commercial power plants – electrical power plants.
- Municipal power plants – combined heat and power plants, heating plants and local boiler houses.
- Industrial power plants – boiler plants operating for the needs of chemical industry, machine-building industry, clothing industry, metallurgy, woodworking, mining.
- Industrial processes – desulfurization of exhaust gases formed in manufacturing processing.

Amount of wastes formed within the above mentioned plants have been compared in figures 2–5.

Investigation proves that lime methods are most frequently used in flue gas desulfurization plants. Wet limestone method is used in large commercial power facilities. In municipal power facilities the dry lime method is most frequently applied, while in the industrial boilers wet lime method or semi-dry lime method is used (figure 6).

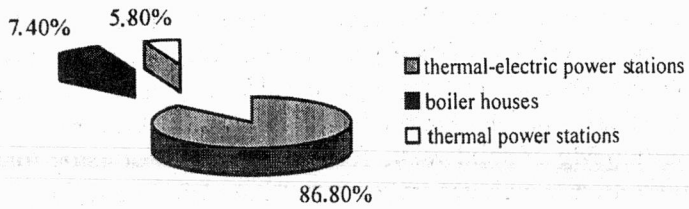

Fig. 3. Share of FGD wastes produced in municipal power plants

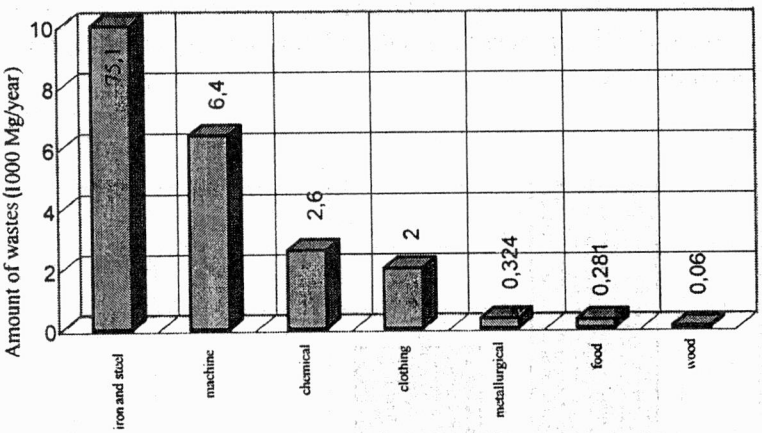

Fig. 4. Comparison of waste amount from FGD produced in various branches of production

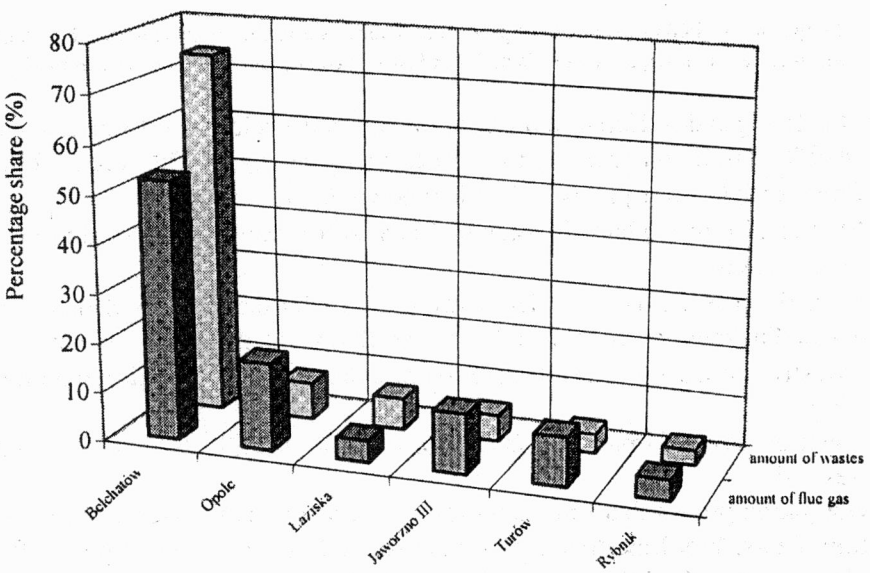

Fig. 5. Percentage share of flue gases purified in commercial electric power plants and FGD wastes versus total volume of flue gases and wastes, respectively

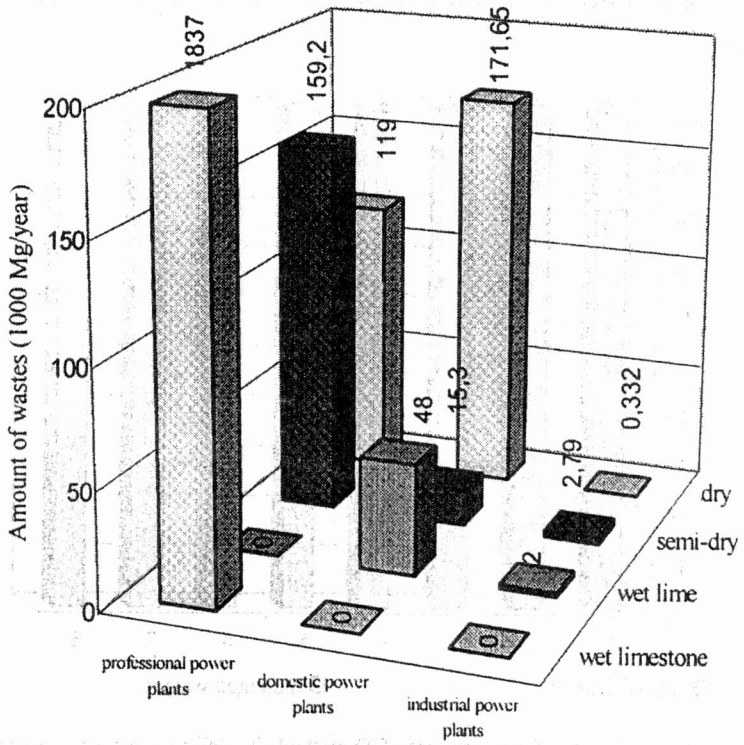

Fig. 6. Comparison of lime/limestone methods of FGD used in various branches of production in terms of the amount of wastes produced

2.2. WASTE UTILIZATION – PRESENT STATE AND FUTURE PROSPECTS

Owing to information collected on waste from the flue gas desulfurization, it was possible to prepare data allowing for further assessment of waste management, depending on the desulfurization method applied (figure 7). The above-mentioned survey reveals that storage of the waste is still most common (80% of waste is stored) and only 20% of waste is being utilized economically, for instance in construction business. Predominantly small- and medium-size companies store the waste from the FGD process and have no prospects for its utilization. Only few companies, besides storing the waste, also sell it to individual clients.

The waste produced in the biggest commercial power plants is the determinant for the global balance of the waste stored and utilized (figures 8, 9).

In "Bełchatów", "Opole" and "Jaworzno III" power plants, the waste obtained, i.e. gypsum, is of wide prospective use. In the main, it is used for manufacturing plaster-cardboard panels. All waste from the "Opole" power plant was utilized in such a way in 1997. Also a part of waste from "Bełchatów" and "Jaworzno" has been similarly rendered harmless before it will be utilized in the future. Waste from the "Łaziska"

power plant is fully utilized and at the same time the new possible applications are being investigated.

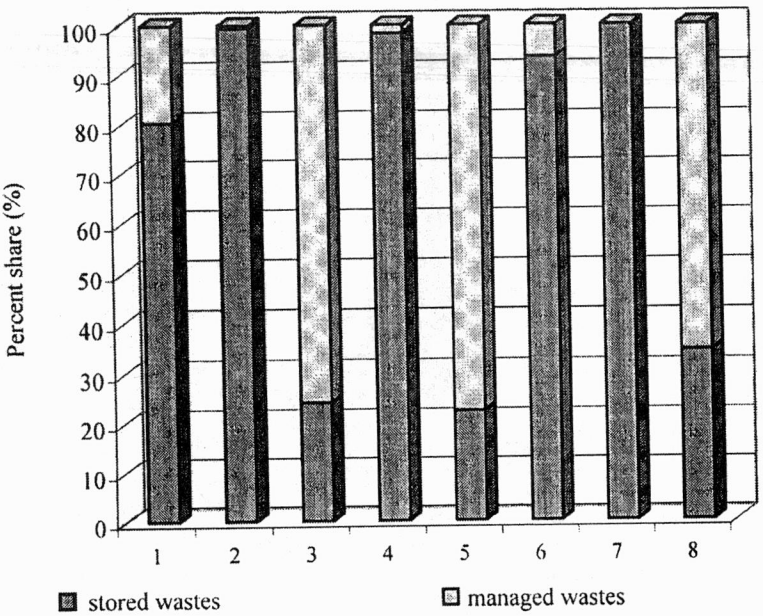

Fig. 7. Management of wastes from different FGD methods in 1997: 1 – wet limestone method, 2 – wet lime, 3 – semi-dry lime/limestone, 4 – dry lime/limestone, 5 – magnesium method, 6 – dual-alkali method, 7 – fluidal bed boiler combustion, 8 – waste sorbents

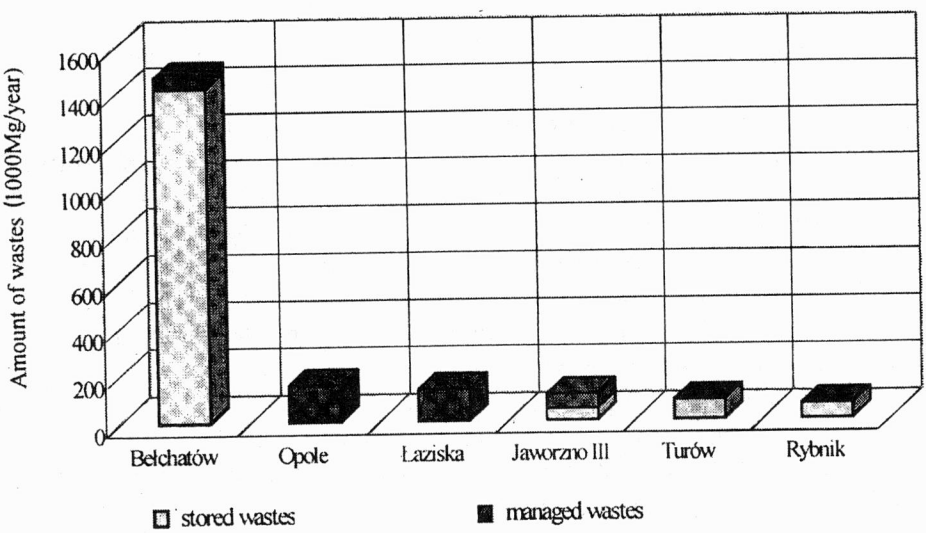

Fig. 8. Management of FGD wastes produced in commercial power plants

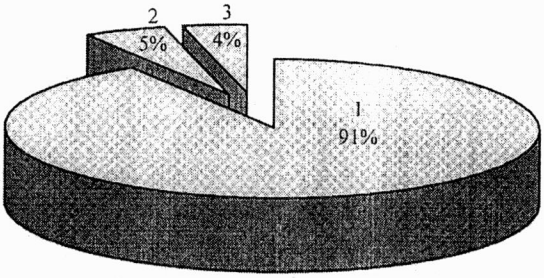

Fig. 9. Management of waste gypsum in the "Bełchatów" power plant:
1 – stored gypsum, 2 – gypsum used for gypsum cardboard production,
3 – gypsum used in cement industry

"Turów" power plant has the fifth position in Poland in respect of waste volume produced in desulfurization process (dry lime method) and all the waste is stored in the hope of future using for reclamation of open cast sites. The worst situation is in the "Rybnik" power plant, where three FGD installations employ the dry method and two other ones – semi-dry method, and all waste is stored with no prospects for its future utilization.

2.3. WASTE STORAGE

Major part of waste produced in domestic FGD plants has been still stored. Both, solid waste and sludge are stored at a cost of 6 PLN per one Mg [5]. Exemplary costs of storage of waste from different FGD processes are presented in table 2.

Table 2

FGD waste storage costs

FGD method	Facility	Waste	Volume stored, Mg/year	Costs, PLN/year
Wet limestone	"Bełchatów" power plant	$CaSO_4 \times 2H_2O$	1 420 161.0	8 520 966
Wet lime	"Energetyka-Rokita"	$CaSO_4 \times 2H_2O$	40 464.0	242 784
Semi-dry lime	"Rybnik" power plant	$CaSO_3$, $Ca(OH)_2$	25 228.8	151 372.8
Dry lime	"Turów" power plant	$CaSO_4$, $CaSO_3$, CaO	81 190.0	487 140
WAWO method	"Wrocław" combined heat and power plant	$CaSO_4$, $CaSO_3$, CaO, ash	7 000.0	42 000

Rough calculations presented in table 2 indicate that the annual waste storage costs are substantial. Also chemical composition of the waste implicates its significant impact on environment.

3. CONCLUSIONS

On the basis of the investigations conducted the following conclusions can be drawn:

- FGD technology in Poland has been dominated by the lime methods.
- The operation of FGD installations in the biggest commercial power facilities is based on the limestone method (in 1997, 74% of exhaust gases were treated by this method).
- 2 441 760.8 Mg of waste were produced in domestic FGD installations in 1997, 86.6% of this volume – in commercial power plants.
- Synthetic gypsum constituted 80.3% of FGD waste produced in Poland in 1997.
- Only 20% of FGD waste were utilized in Poland in 1997.
- Waste from the wet limestone/lime method is utilized for manufacturing cardboard/plaster panels or as an additive in cement production; waste from the dry and semi-dry methods – for roads and yards surfacing and, to a small extent, in construction trade.
- The waste storage is still widely used, especially by the municipal power facilities and by the industrial power facilities as well.

REFERENCES

[1] TRZEPIERCZYŃSKA I., *Charakterystyka i możliwości utylizacji odpadów z odsiarczania spalin*, Ochrona Środowiska, 1997, No. 1.
[2] GAWLICKI M., *Możliwości zastąpienia w przemyśle materiałów budowlanych gipsów naturalnych produktami odsiarczania spalin*, Materials of the 2nd Conference Opolwap S.A., Tarnów Opolski, 1995.
[3] PIETROŃ J. et al., *Gips syntetyczny z pierwszej w Polsce instalacji odsiarczania spalin w elektrowni Bełchatów*, CWG, 1995, No. 3.
[4] *Ochrona środowiska*, GUS, Warszawa, 1999, Informator.
[5] Dziennik Ustaw, No. 162, 31, December, 1997, pos. 1116.

GOSPODARKA ODPADAMI Z ODSIARCZANIA GAZÓW ODLOTOWYCH W POLSCE

Na podstawie ankiet rozesłanych w 1998 r. do zakładów przemysłowych w Polsce, mających instalacje do odsiarczania spalin, zebrano informacje na temat stosowanych metod odsiarczania, ich udziału w ilości spalin oczyszczanych w ciągu roku, liczby instalacji pracujących według danej metody, ilości odpadów powstających w instalacjach, składu odpadów oraz ich wykorzystania. Uzyskano odpowiedzi na 73% rozesłanych ankiet i na tej podstawie dokonano podziału instalacji na grupy ze względu na stosującą je branżę produkcyjną. Oceniono stan nagromadzenia i wykorzystania oraz perspektywy zagospodarowania odpadów z odsiarczania spalin w poszczególnych gałęziach gospodarki.